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### BARBERRY ERADICATION PREVENTS BLACK RUST IN WESTERN EUROPE.

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#### DESTROYING BARBERRY STOPS RUST.

**B**LACK STEM RUST of wheat, oats, barley, and rye has been controlled in much of western Europe by eradicating the common barberry.

This is not a theory. It is a fact.

Since the barberry-eradication campaign was begun in the United States much has been heard about how Denmark prevented destructive epidemics of black stem rust by eradicating barberry bushes. Less was known about what other countries had done. Many people in the United States asked whether there was good evidence that exterminating barberries would control black rust. The exact effect of eradicating the bushes in countries other than Denmark was not well known. The writer therefore was asked by the United States Department of Agriculture to go to Europe and study the situation during the spring and summer of 1922.

Black rust does no appreciable damage in those countries of western Europe (Fig. 1) from which barberry bushes have been removed.

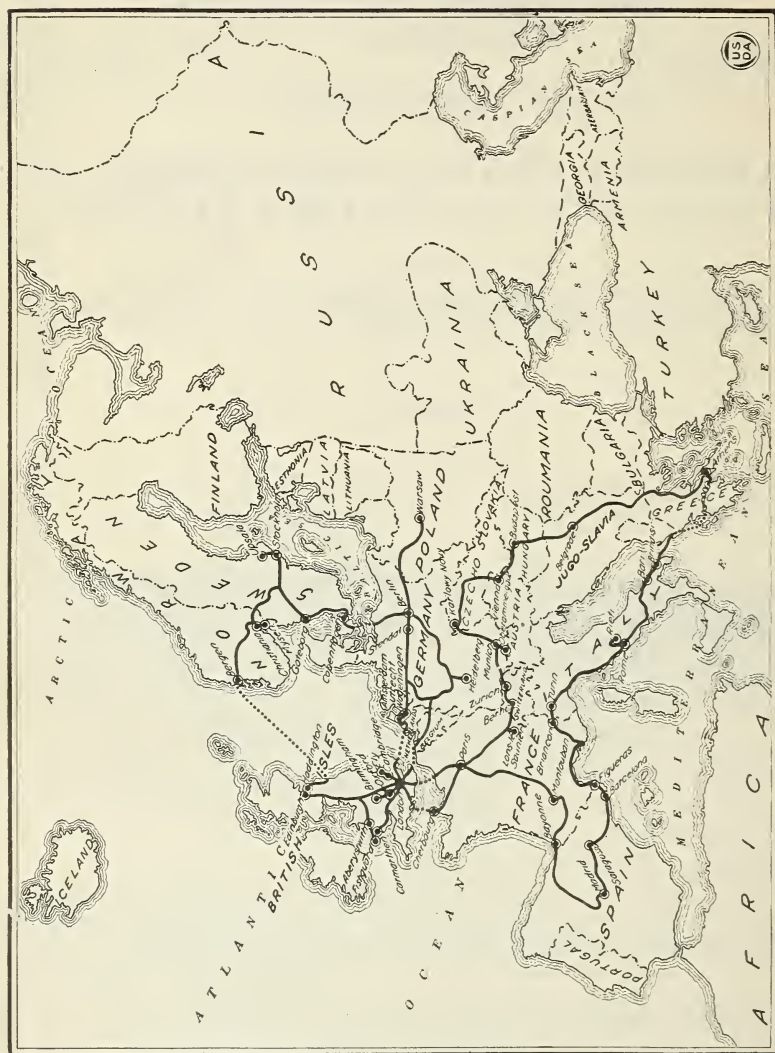


FIG. 1.—Sketch map of Europe, showing the route traversed by Doctor Stakman and the places in the different countries where he made observations on the occurrence of rust and of common barberries in the months from May to October, 1922.

But it is extremely destructive where there still are barberries. This conclusion is inevitable for anyone who examines the evidence carefully.

Barberries are rare in the best grain-growing districts of England, Denmark, much of Germany, Belgium, Holland, France, Spain, Italy, Austria, Czechoslovakia, and Hungary. This is clear from the statements of agriculturists in those countries, and the writer is convinced of the fact from personal observations. In the mountains and in some wooded lands there still are bushes and there still is rust. But in those districts in which the bushes have been destroyed the rust does practically no damage, although in many of them it formerly was very destructive.

#### HOW ENGLISH FARMERS PREVENTED RUST.

It is difficult to find black stem rust in England, but this was not always so. More than 200 years ago English farmers complained that black rust ruined grain crops growing near barberry bushes. So they showed their good sense by destroying the bushes. And they destroyed the rust by killing the bushes on which it got its start in the spring. So thoroughly did the English farmers exterminate the destructive barberry that one can drive for miles through the country districts without finding a single bush. One English botanist told the writer that he could drive from London to Cambridge, a distance of about 50 miles, without being able to find a single bush. There are many hawthorn hedges, but the barberry hedges are almost a thing of the past. And so is black stem rust. Every English plant pathologist with whom the writer talked regarding the matter was convinced that the eradication of the barberry has solved the black stem-rust problem in England.

#### BARBERRY AND BLACK RUST IN WALES.

In Wales the situation is quite different. The farmers in that country have not yet destroyed their barberry bushes. W. H. Broadbent, of the Ministry of Agriculture, investigated the situation in three counties in 1920. In one of them he found barberries on 60 farms out of the 100 which he visited. In another county he found bushes on 30 farms of the 40 which he visited.<sup>1</sup> In the third county, in which a systematic search was not made, he found barberry bushes in 14 parishes. In this county he found one hedge 100 yards long and another about 30 yards long. Furthermore, in these three counties he found 74 outbreaks of rust, and in every case barberry bushes were near the fields. Broadbent summarizes the situation as follows:

(1) It is ascertained by means of the survey that the common barberry is widely and plentifully distributed in Carmarthenshire, Pembrokeshire, and South Cardiganshire. The cluster-cup stage of the black-rust fungus is abundant on the barberry in spring and early summer.

(2) On the wheat, black rust may be said to be generally distributed over the same area and causes serious losses every year. In certain seasons the attacks are very severe.

(3) Wheat is regarded as a risky crop in these counties and is certainly not a paying one in barberry areas. As a result there is a reduced acreage under wheat, and this is diminishing.

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<sup>1</sup> Broadbent, W. H. Report of the barberry and the black rust of wheat survey in southwest Wales. Reprinted from the Journal of the Ministry of Agriculture, v. 28, no. 2, p. 117-123, May, 1921.

(4) The common barberry is the alternate host of black rust, giving the fungus a good start each spring. In several concrete cases field observations showed that the disease was most intense near the bushes and had started from them. As long as the barberry is allowed to remain it will be a constant source of infection, not only to the adjacent wheat fields but to other fields on which the summer spores from the wheat will be blown. (Fig. 2.)

(5) In more than one case the removal of barberry bushes resulted in slighter attacks on adjoining fields than in the previous season, but until barberries are eradicated on a wholesale scale no complete elimination of the disease can be expected, owing to spores blowing from other fields. Every bush destroyed

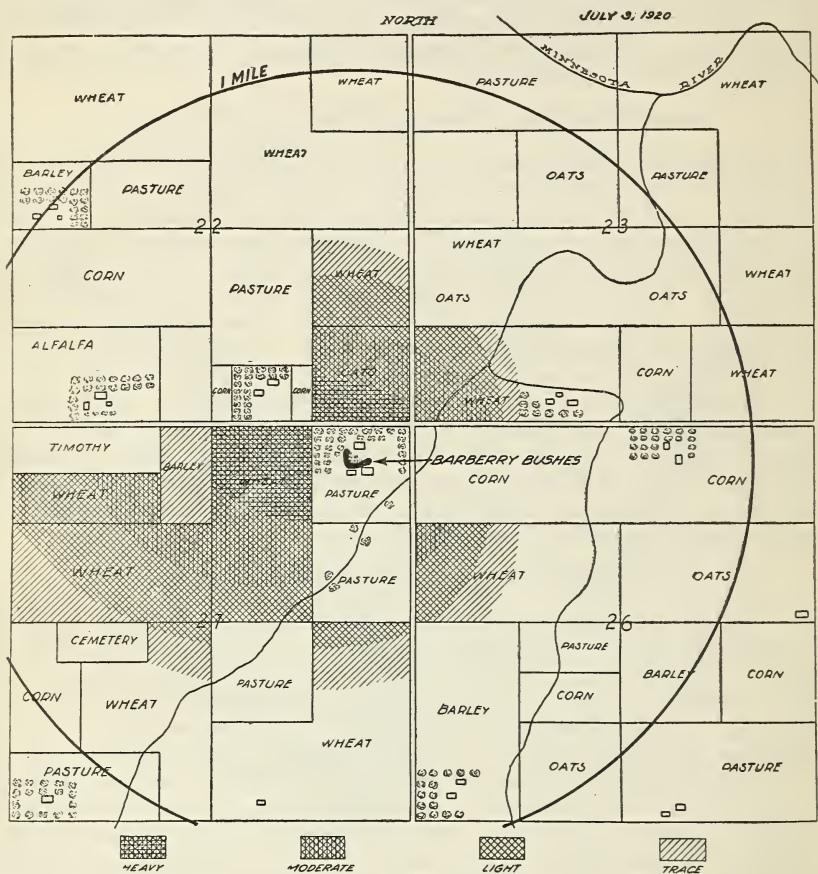


FIG. 2.—Map showing the spread of black stem rust from a hedge of common barberry on section 27, Sisseton Township, Roberts County, S. Dak., on July 3, 1920. The density of the shading is in proportion to the severity of rust infection on grains and grasses in the surrounding fields.

means so many less initial infections, and the fewer the infections the better will be the wheat crop.

(6) Black rust is very scarce in all other parts of the British Isles, and there appears no reason to doubt that if the barberry were exterminated in Wales the annual attack of black rust on wheat would subside. This method was adopted in Denmark 18 years ago, and black rust in that country has now practically ceased to exist.

It may be further noted that in 1920 the Ministry of Agriculture made a special effort to ascertain all cases of black rust in the country. England as a whole was found to be remarkably free from the disease, and the common

barberry is scarce. A few quite small outbreaks were located, the worst case, in Gloucestershire, being in immediate proximity to badly rusted barberry in a hedge. Many farms in parts of Devonshire and Cornwall (which counties have a similar climate to southwest Wales) were examined, and no case of black rust was observed, and during the inspection hardly a single bush of the common barberry was met with.

#### **RUST IN THE BRITISH ISLES DEPENDS ON BARBERRY.**

The writer traveled many miles in various parts of England and found no trace of black stem rust, except near three barberry bushes which were located by an eminent English mycologist. In Scotland the only stem rust which could be found was near some barberry bushes in a hawthorn hedge. Near these bushes the rust was abundant; elsewhere there was none. British agriculturists stated that black rust is practically unknown in England and Scotland except near barberry bushes.

Through the courtesy of the director of the Welsh Plant-Breeding Station the writer was given the opportunity to travel quite extensively in the grain-growing districts of Wales. The responsibility of the barberry bushes for rust outbreaks is absolutely clear. The farmers are beginning to realize this, and they no doubt will stop the rust by killing the bushes, as the English already have done.

It is a high tribute to the good sense of the English farmers that they eradicated the barberry—even without the aid of a law. They were among the first to realize the destructive effect of this worse than worthless bush. They preferred to destroy barberries rather than to permit the barberries to destroy their grain, and they have their reward. They no longer fear the dreaded black stem rust. They have prevented it by digging their barberry bushes. Other countries of Europe have had equally good results.

#### **DENMARK KILLS BARBERRY AND STOPS RUST.**

Denmark also has prevented attacks of black stem rust by eradicating barberry bushes. If there ever was an established scientific fact, this is one. For years rust attacks had been severe in Denmark. Barberry bushes had been brought into Denmark and planted some time during the seventeenth century. By about 1805 they had become so numerous that black rust began to be destructive. Many farmers destroyed their bushes and noticed that the severity of rust decreased as a result. They therefore demanded that their neighbors do likewise. But many refused because they couldn't see how barberry bushes could have any influence on the development of rust. There arose a bitter quarrel, which lasted for over 50 years. Finally, in 1869, a law was passed which gave everyone the right to demand the extermination of barberry bushes. But the law did not result in the complete elimination of the bushes, and the severity of black rust increased. There are accurate records since 1889. In 1889, 1894, 1895, 1896, 1897, and 1901 the rust was very destructive, and it also did considerable damage in 1893 and in 1900.<sup>2</sup>

Then a law was passed requiring the complete destruction of barberry, except in botanical gardens and a few other restricted areas.

<sup>2</sup> Lind, J. *Berberisbusken og Berberisloven*. (The barberry bushes and the law.) *IN Tidsskr. Planteavl.*, Bd. 22, p. 729-780. Kobenhavn. 1915.

The law became effective January 1, 1904. The eradication campaign was effective. Not only were the bushes destroyed, but the black rust also practically disappeared. Since 1904 there has not been a single general epidemic of rust in Denmark. The rust seldom is found, and when it does occur a guilty barberry also is found. In 1914 Lind wrote:

We can not deny that here in Denmark we have as definite proofs as we can obtain about the hand-in-hand elimination of the barberry bush and the black rust.

The writer traveled many miles with one of the Danish pathologists during the summer of 1922 and found no trace of black rust, except near a few barberry bushes which still remained in a wooded area. Denmark has solved the black-rust problem by eradicating the barberry. No wonder neighboring countries are following her example.

#### NO BLACK RUST WITHOUT BARBERRY IN NORWAY AND SWEDEN.

Agriculturists in Sweden are making desperate attempts to secure the passage of an effective barberry-eradication law. And well they may. If anyone doubts the beneficial effect of destroying the barberry he should travel from Denmark to Sweden. There are enormous numbers of barberries in some districts of Sweden, and the attacks of black rust in those regions are terrific. Between Stockholm and Upsala, in the summer of 1922 fields of oats were black with rust, which could be traced directly to the barberry bushes. This is no unusual condition. On the contrary, it occurs year after year. The botanist, E. Henning, of the Central Experiment Station at Stockholm, writes as follows:<sup>3</sup>

In certain districts of the country it is almost impossible to grow oats, since there are so many shrubs of *Berberis*; for instance, near Strangalis and Vesteras, etc. The rust forces the farmer to use early, relatively poorly yielding varieties of oats, which actually represents a national loss. Now, valuable improved varieties are threatened with destruction. Nilsson Ehle writes: "The rust consequently constitutes a hindrance for transforming into practice and its benefits the work dealing with improvement of cereals."

And again Henning writes:

The necessity of such precautions is readily seen and appreciated, judging from the experiences in middle Sweden last summer, when the crop of wheat and oats on several estates became a failure on account of the presence of *Berberis*, as well as the fact that in several districts where the shrub abounds it has long since been deemed futile to grow oats, since these are continuously destroyed by black rust.

Henning also points out that rust did not become destructive in Sweden until barberry bushes escaped from cultivation and became numerous. (Fig. 3.) Even at the present time the rust practically is unknown in those districts of Sweden, especially in the north and west, where there are very few barberries. When rust does occur in those districts it can be traced to barberry.

A barberry-eradication law was passed in Norway in 1916. As a result of long experience it was found that where there were bar-

<sup>3</sup> Henning, E. Lagstiftningen mot *Berberis* busken med särskild hänsyn till frågans nuvarande läge i vårt land. (The legislation against the barberry shrub with special regard to the present status of the question in our country (Sweden).) Tidskr. f. landtmän, 1916, p. 1-15. Lund, 1916.

berry bushes there was rust and that where there were no bushes the rust was unimportant or absent. It was found also that when the bushes were eradicated rust was no longer destructive. This is shown in the following quotations from Henning:<sup>4</sup>

During the years 1890-1892 many shrubs were cut down, and Schöyen (1892) writes about this matter: "In the districts where the shrub had been exterminated thoroughly the barberry rust was not to be observed upon the cereals any more, or the rust appeared much more scant than where the shrub had been permitted to stay, because the property owners did not believe in the danger of growing the *Berberis*."

During the succeeding 20 years no new suggestion was made with regard to exterminating the shrub, and since the shrub had thus been left in peace and allowed to multiply, the black rust has appeared in abundance and caused heavy devastations in the districts of Akerhus and Bratsberg. On several

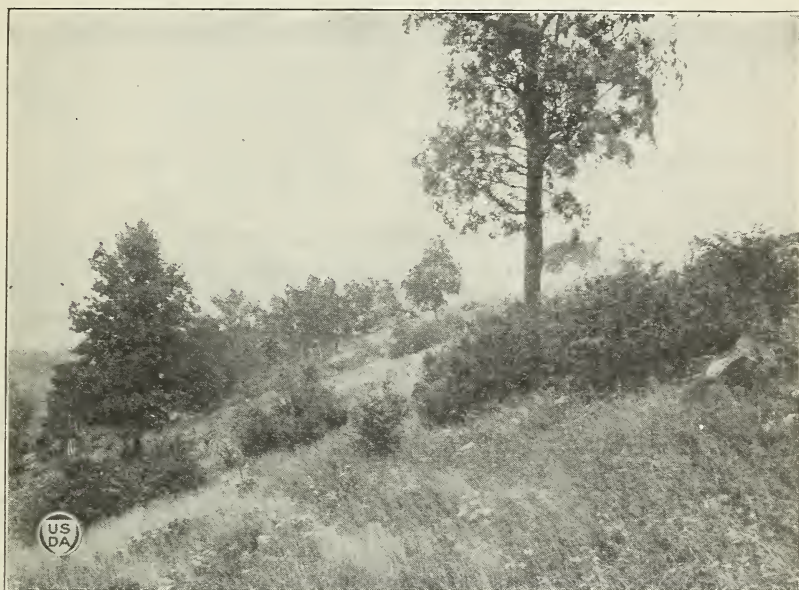


FIG. 3.—Escaped barberries growing from seed scattered by birds on a wooded hillside pasture near Galena, Ill., July, 1922.

estates in Aker district oats are cultivated no longer. Even in the Hedemark district black rust devastated heavily about 20 years ago, but at present the rust is of very small importance in that district, since the shrub has been exterminated on a very great scale by private concerns.

### LITTLE BLACK RUST IN CENTRAL EUROPE.

Germany has been fighting rust for many years by eradicating barberry bushes. Schaumburg-Lippe in 1805 required by law that all barberry bushes should be removed by December of that year. The Bremen Senate passed a law in 1815. There now are 25 laws and police orders in various political subdivisions which require the removal of barberry. The last one was passed by Bavaria in

<sup>4</sup> Henning, E. Den norske *Berberis* lagen och dess forhistoria. (The Norwegian barberry legislation and its early history.) Landtmannen, 27th year, No. 42, p. 1-8. Linköping, 1916.

1920. As a result the bushes are not common. Neither does black stem rust do much damage. German pathologists state that when destructive outbreaks occur they can be traced to barberry bushes. Hiltner<sup>5</sup> summarizes the effect of the eradication as follows:

Even if it is definitely established that the black rust of cereals often does not disappear entirely when all barberry bushes have been removed carefully from the vicinity, nevertheless it has always been found that the rust in such cases loses its great danger and that therefore by means of the destruction of barberry bushes which are growing in the neighborhood of cereal fields (and the commercial value of the barberry is very slight) serious losses of straw and grain can be prevented.

The writer looked long and hard for black rust in Bavaria about the middle of July, but could find none. German pathologists predicted this, but they said that in the mountains there were many barberry bushes. And there the rust was found on barberry and on grains.

In Holland black rust scarcely ever occurs, and barberry bushes are rare. When asked why there were no more barberry bushes in his country, one Dutch pathologist replied, "Holland is a small country and must feed a population of about 7,000,000. We can't afford to grow barberry bushes, and we don't do it." Wise Dutchman!

There are but few barberry bushes in the best grain-growing regions of Czechoslovakia, Austria, and Hungary, although they still exist in the mountains. A law was passed in Steiermark, Austria, as early as 1882. The Ministry of Agriculture of Hungary issued an order in 1920 requiring the destruction of the bushes.

In Serbia barberry bushes are fairly common. So is black stem rust. From personal observations and from statements of Serbian botanists it is evident that rust usually gets its start from barberry bushes. It appears earliest and is most destructive near the bushes. Later it may spread to other fields.

According to Jaczewski, an eminent Russian plant pathologist, the æcidial stage of black stem rust (*Puccinia graminis*) occurs on the common barberry throughout Russia. There is no evidence to show that the red stage of black stem rust survives the long, cold winters of northern and central Russia. It is probable that the barberry also is an important factor in starting epidemics even in the southernmost regions of the country. Apparently no attempt has been made to compel the eradication of the barberry in Russia.

Black stem rust does very little damage in France. There are practically no barberry bushes in the good farming districts. A general crop-pest law was passed in 1888. Under the authority granted by this law the destruction of barberry bushes has been required in many local political units. The preamble to a law passed in 1891 in the Department Eure-et-Loire reads as follows: "Whereas it is known that the proximity of barberry constitutes a veritable scourge to grain fields." The scourge has been removed from most of them. As a result, when black rust appears at all in the great cereal districts of France, it comes too late to injure the grains. Voisin, according to Foëx,<sup>6</sup> makes the following statement: "On an

<sup>5</sup> Hiltner, L. Der Schwarzrost des Getreides und die Berberitze. Flugblätter zur Förderung des Pflanzenbaues und des Pflanzenschutzes, Nr. 36. May, 1920.

<sup>6</sup> Foëx, Étienne. Rouilles des Céréales. 116 p. Montpellier. 1908.

estate the rust diminished greatly after the destruction of a hedge which contained many barberries." During the past summer not a trace of the rust could be found on wheat, barley, rye, or oats after a long search extending from Paris to the southern border of the country. There were no barberry bushes to give it a start.

But in the Alps there are tremendous numbers of barberries. They were yellow with rust. And the rye was black with it. The writer counted 13 bushes in one small rye field. The rye already was on the road to almost complete annihilation. A peasant woman said the same thing happened every year. She said they did not try to grow wheat, because the rust ruined it. At this same time not a trace of rust could be found in those districts where there were no barberries. Yet some people in our own country insist that barberry eradication is a snare and a delusion. The results in France are all the more remarkable because the climate, at least in the south, is so mild. One might expect that the summer stage of the rust would live over the winter there. But the conditions still farther south are even more surprising.

### BARBERRY DANGEROUS EVEN IN SOUTHERN EUROPE.

Even in the most southern countries of Europe the barberry spreads rust. Where the weather is relatively warm during the winter the summer stage of rust sometimes lives through the winter, and the rust thus becomes independent of the barberry. However, even in Spain and Italy, the rust evidently is most destructive near barberry bushes. The bushes are numerous in certain mountain regions, but are very scarce elsewhere. The most eminent mycologist of Spain stated that in his country rust always appeared earliest and was most injurious near barberry bushes.

The same is true of Italy. In that country barberry bushes are abundant in the mountains of the north. There the black rust causes the greatest losses. According to a very able Italian mycologist the rust is relatively unimportant in the south, where there are practically no barberries. Certainly no one could study the situation in 1922 without being convinced that this conclusion was correct for that year. Even as far south as Rome barberries can spread rust to wheat. In 1913 wheat was destroyed by black rust in a restricted area about 60 miles southeast of Rome. The attack was traced to three barberry plantings. All but one of these was removed in 1913. In 1914 the rust developed only near this plant. It was then destroyed and rust did not appear again.<sup>7</sup> And this in sunny Italy!

Barberries may be destructive even in southern Greece. There are many wild bushes of a native species in the mountains of that country. During the past summer the writer could find no black stem rust on the wheat which had grown on the Attic Plain near Athens. But in the mountains on the edge of the plain there were thousands of native barberries (*Berberis cretica*) at elevations of 3,000 feet. They were covered with rust. Wild grasses near by were rotten with rust. The wind easily could blow the rust to grains in the valleys. Indeed it would be strange if it did not. It is quite probable that much of the rust in Greece comes from these barberries. It is un-

<sup>7</sup> Campbell, C. An invasion of the black stem rust of cereals in Terra di Lavoro. In *Atti R. Accad. Lincei Rend.*, v. 28, p. 142-145. 1919. *Bot. Abs.*, v. 6, p. 183. 1920.

likely that the summer stage of the rust overwinters in many regions of Greece. This is not because the winters are severe, for they are not. But the summers are so hot and dry that few grains and grasses remain green during the terrific heat. Consequently there are no plants on which the summer stage can live during this unfavorable period, and it must be carried over by the more resistant black stage, which can go only to barberry in the spring.

### EUROPE CONTINUES THE FIGHT.

Europe never will be entirely free from black stem rust. The barberry bushes can not all be eradicated from the mountains, where they are wild. But it is perfectly clear that most of the countries of western Europe do not tolerate them in grain-growing districts. Some of these countries have avoided planting many of the bushes. Other countries have undone most of the evil which was unwittingly done in planting them and permitting them to escape from cultivation. The results are remarkable.

It has been demonstrated clearly by several countries that black stem rust can be controlled by eradicating barberries. The rust depends on the barberry in most of western Europe. Since the bushes have been removed the rust either has disappeared entirely or it comes so late in the season that it does but little damage. But in those sections in which there still are many barberries the rust continues to destroy grain crops at an alarming rate. These countries realize the danger. They follow the example set by England, Denmark, and other countries which controlled rust. Within the past few years Norway, Bavaria, and Hungary have passed barberry-eradication laws. The fight is still on.

### NO VALID OBJECTION TO ERADICATING BARBERRY.

How anyone can honestly object to destroying the barberry is a puzzle. But some people in the United States still do.

Europe had her objectors also. During the time from about 1750 until 1865, when the evidence against the barberry was accumulating, many refused to accept the facts. It was not strange. No one knew just how rust could come from barberry. The nature and habits of the rust parasite were not understood. It was natural that many intelligent people did not believe what they could not understand. It was shown by experiments, about 1865, just how barberry could spread rust. That seems to have satisfied most Europeans.

What excuse can there be in this country for objecting to a measure to prevent rust from destroying grains? For 250 years or more farmers in Europe knew that barberry destroyed their grain. They insisted on the fact so strongly that scientists finally studied the question and agreed with them. Then at last several countries did a thorough job of eradicating barberries and settled the matter.

### FARMERS CONVICT BARBERRY.<sup>8</sup>

The most convincing evidence against the barberry in the early days was the testimony of farmers. As early as 1758 Erhart wrote

<sup>8</sup> The early observations on the destructiveness of the barberry are well summarized by Klebahn, H. *Die wirtswechselnden Rostpilze*. xxxvii, 447 p., illus. Berlin. 1904.

as follows in his *Economic Plant History*: "In England they (the barberries) are in bad repute because the common people are of the opinion that they cause brand (rust) in the near-by grain." It is related that in 1720 a man became so angry at seeing a large barberry bush on a neighbor's farm, but near his own wheat, that he poured boiling water around the roots of the plant at night until he had killed it. Withering, in 1776, wrote as follows: "The shrub should never be permitted to grow in cornland, for the ears of wheat that grow near it never fill, and its influence in this respect has been known to extend as far as 300 or 400 yards across a field."

Even in the colony of Massachusetts a law was passed in January, 1755, providing that all barberries must be destroyed by June 13, 1760. The preamble reads as follows: "Whereas, it has been found by experience that the Blasting of Wheat and other English Grain is often occasioned by Barberry Bushes, to the great loss and damage of the inhabitants of this province."

Willdenow, in 1804, observed that grain near Potsdam in Germany never yielded well when grown near barberries. He observed, however, that the grain did yield well after the barberries had been removed. He therefore thought that the rust on the barberry actually transferred to the wheat. Retizius stated in 1806 that grains near barberry bushes were especially severely attacked by rust. Schöler, a Danish schoolmaster, about 1815 came to the conclusion that the rust actually was carried by the wind from the barberries to the grains. So thoroughly convinced were the farmers of the village in which Schöler lived that the barberries were responsible for rust that they requested him to destroy his bushes. He did so. The following quotation from Lind gives some of the experiences of Danish farmers:

Dean Hejberg from Kirkesaaby published in the best newspaper of the time, the *Economical Annals*, edited by Olufsen, a story of what had happened in his experience. His fields were divided in 1795 and inclosed by barberry bushes in 1796. In 1797, 8 tdr. of rye, which had been sown next to a barberry hedge, was destroyed and the oats were spotted with black. The following year 8 tdr. were again without any kernels. It was always the field next to the hedge that was destroyed. In 1803 some of the bushes were removed and the rye growing beside the vacant space was good, while that beside the bushes was again spoiled. Hejberg writes: "The exhalation from the barberry bush was effective at a distance of 60 miles." Rev. Mr. Junge, from Bloustrød, wrote the same year about a farmer who used the barberry for a hedge which "thrived well but had a serious effect; it gave the straw shelter, but the seed death." His neighbor, Rev. Mr. Kjaer, from Ljunge, had a promising crop of oats totally destroyed in the same way.

But every one did not agree with the farmers. For example, it is stated in Duhamel's *Traité des Arbres*: "Many insist that the flowers of the barberry prevent wheat from producing kernels. I have not investigated the matter but consider it improbable." The objections of many people to-day rest upon the same sort of a foundation. In Krünitz's *Oeconomische Encyclopädie*, 1774, the following statement is made: "It (the barberry), without grounds, has been accused of causing brand (rust) in near-by grain. For this reason they (the barberries) have even been banished from hedges around farms."

So sharp were the differences of opinion that a so-called barberry war raged from about 1805 until 1865. Farmers, whose grain

had been destroyed by rust which spread from barberry bushes, often destroyed the offensive bushes. They often did not even ask the owner's permission. The following case is cited by Lind:

Hald (1827, p. 104), from the estate at Rander, writes: "The peasants strive with all their power to uproot this plant. They are successful in some places—the estate at Stovring being an example. A few years ago a barberry hedge was found here. When the peasants in the country believed this to be the cause of the rust on their rye, they proposed the extermination of this barberry hedge several times, but without avail. Finally they became so angry that they armed themselves with axes and in large numbers entered the estate and demanded permission to destroy the bushes. The director, under such circumstances, could not deny their request."

### RELATION OF BARBERRY TO BLACK RUST SCIENTIFICALLY PROVED.

Scientists finally tried to find out whether the farmers were right. They were.

Marshall in England in 1781 was told by a farmer that rust came from barberry. He decided to find out for himself. In the spring of 1782 he planted a large bush in a wheat field. He wrote as follows concerning the effects: " \* \* \* about the Barberry bush there appeared a long but somewhat oval-shaped stripe of a dark livid color, obvious to a person riding on the road at a considerable distance."

He tried it again the next year and noticed the same thing.

During the next 80 years many scientists tried to find out just exactly how barberry spread rust. Many of them offered rather ingenious theories. All who investigated the question were convinced that the bushes did spread rust, even though they did not understand exactly how.

In 1865 DeBary, a German scientist, finally cleared up the matter. He made careful experiments and found that the life history of the rust parasite is as follows: The black stage of the rust lives through the winter. It can not infect grains or grasses. The spores (seeds), however, do infect the common barberry, on which they produce the cluster-cup stage of the rust. These cluster-cup spores are then blown by the wind and infect grains and grasses, on which they produce the red or summer stage of the rust. This stage continues to propagate and spread until fall, when the black stage again is produced.

Hundreds of scientists have shown that DeBary was right. No one any longer would dispute the fact.

The barberry stands convicted. Farmers proved that the common barberry spreads rust. Scientists showed why and how. Both have shown that rust epidemics disappeared when the bushes were destroyed.

### LESSONS FROM EUROPEAN EXPERIENCE.

It is clear from the experience of Europe that the only way in which to eradicate barberries effectively from large areas is by a vigorous campaign. While the barberries have been eradicated from England without the aid of a law, the general experience of other countries is that legal measures are necessary. This is perfectly clear. Even though farmers were almost universally convinced of the

necessity for eradicating barberries as long as 200 years ago, it was impossible for them to get rid of all the bushes. There always were some persons too ignorant or too lazy to do the work. Each generation often had to learn the lesson anew.

Many local attempts were made to eradicate barberries. The evidence is that whenever the bushes were removed the rust either disappeared entirely or the severity decreased. In many regions there were so many bushes that local eradication was not sufficient to protect the crops, because the rust blew in from some unprogressive neighbor's bushes. It is a striking fact also that when the bushes sprouted again, on account of having been imperfectly dug, the rust reappeared in those regions from which it had disappeared after the barberries had been dug.

The cheapest and most effectual method of eradicating barberry bushes unquestionably is to make it compulsory and then carry on a campaign on a large scale. This is what the United States Department of Agriculture and the 13 States of the upper Mississippi Valley now are doing in the United States. It would be a calamity not to carry this campaign through to a successful conclusion. The evidence against the barberry in the United States is just as conclusive as it is in Europe.

#### EVIDENCE AGAINST BARBERRY IN THE UNITED STATES.

Conditions in Europe are not essentially different from those in this country. There are tremendous numbers of bushes in the upper half of the United States. These bushes rust heavily in the spring. The rust spreads to grains and grasses, and terrific damage often results.

The question often is asked how far rust can spread from a barberry bush. There sometimes is an idea that it can not spread far. But it can. (Fig. 2.)

During the past year spread of rust to grasses and grains in Minnesota was traced directly more than 10 miles from a single barberry hedge. How far the wind blew the rust from this area no one can say. (Fig. 3.)

A single barberry bush can cause extensive losses. During the past summer Prof. H. S. Jackson,<sup>9</sup> of Purdue University, made the following observation:

One thing that has greatly interested us this summer, and on which Mr. Beeson, our State leader, made a special study, was an outbreak of stem rust which started from one barberry bush. It traveled in one direction, at least, for about 5 miles. The area was pretty carefully surveyed and I have a report here containing figures given by the farmers themselves on 18 out of perhaps a total of twice that many farms. The total wheat area was 963 acres. The average yield due to stem rust was 8.1 bushels. The average estimate of yield had there been no black stem rust was 21.4 bushels. The average crop this year was then 37 per cent of what it would have been without the black stem rust. The total loss in yield was 12,520 bushels, or an average loss of 696 bushels. At a dollar a bushel each farmer lost \$696 worth of wheat. The combined money loss was \$12,520. I might say in this connection a thing which I have been willing to say before. We feel that we have in the evidence in Indiana proof that where we take out the barberry we have no more trouble with stem rust. That has been proved for the years that the campaign has

<sup>9</sup> Jackson, H. S. *In Proceedings of the Second Annual Conference for the Prevention of Grain Rust.* Nov. 14, 1922.

been continued. We have any number of cases where there was formerly serious stem rust traceable to the barberries which have now been removed with the result that no signs of rust appeared this year.

Is there any excuse for keeping a bush which can cause a loss of \$10,000 in a single year? Not only can one bush cause this loss, but it produces seeds from which more bushes grow. We can not afford to grow barberries. The barberry has destroyed too much grain in the past. It will multiply and destroy more in the future unless we destroy it first. Europe has controlled rust by eradicating the common barberry. Surely we should be as progressive.

**M**ANY COUNTRIES in western Europe have stopped destructive attacks of black rust by exterminating the common barberry.

Since 1918 the United States Department of Agriculture has been carrying on a campaign for eradicating barberry bushes. Montana, Wyoming, Colorado, Nebraska, South Dakota, North Dakota, Minnesota, Iowa, Illinois, Wisconsin, Michigan, Indiana, and Ohio are cooperating.

This destructive bush is under the ban of the law in all of these States. But laws alone will not kill barberry bushes. Only an intelligent public sentiment which arms men with picks, shovels, and rock salt can finish the job.

There still are those in the United States who profess to think barberry eradication either impossible or useless.

European countries got rid of barberry. Surely we can. The bushes had been in most countries over there longer than they have been here. There were more of them in Europe than in the United States. And they were just as hard to kill. It was a long, hard fight over there; it still is going on. Grub hoes and salt killed the bushes there, and they can do it here. Barberries are just as destructive to grain here as they were in Europe. They could not afford to keep them over there; we can not afford it here.

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